

Oil Sands Minerals Analysis using Synchrotron XRD

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Abstract No. omot8584

Beamline(s): X3B1

Introduction: More than 25% of Canada's crude oil demands are met by the commercial development of the oil sands in northern Alberta. Bitumen is extracted from the oil sands via a water based extraction process, and converted to crude oil by hydrogen addition in the presence of catalysts. At mining rates in excess of 500,000 tonnes per day, the extraction process produces a huge amount of mineral/water tailings. Reclamation of this material to an acceptable landscape depends on our ability to identify and quantify the clay and other mineral components. X-ray diffraction is an important tool for the detection of mixed layering in clay minerals, for quantification of all minerals present, and for their grain size analysis. Synchrotron x-ray diffraction may offer important advantages for these measurements. The two figures compare data taken with a 10 kW rotating anode and at NSLS beamline X3B1, both at 1.54 Å.

In **Figure 1**, note that peaks resulting from mixed layering (10-15Å) are better resolved from synchrotron radiation data, and that the detection limit for quartz (4.25Å) is much lower. The amount of amorphous iron is often overestimated in these samples. However, the synchrotron pattern in **Figure 2** readily shows crystalline magnetite, marcasite, and goethite, not visible in the laboratory data.

Conclusions: These examples illustrate the utility of synchrotron radiation over laboratory-based systems for the characterization of oil sands minerals. The ability to more accurately identify and quantify the clay components in tailings streams means that the economics of tailings reclamation can be optimized. Similarly, identification and quantification of mineral components that affect coke formation and catalyst life in the conversion of bitumen to crude oil help in optimization of the refinery operations.

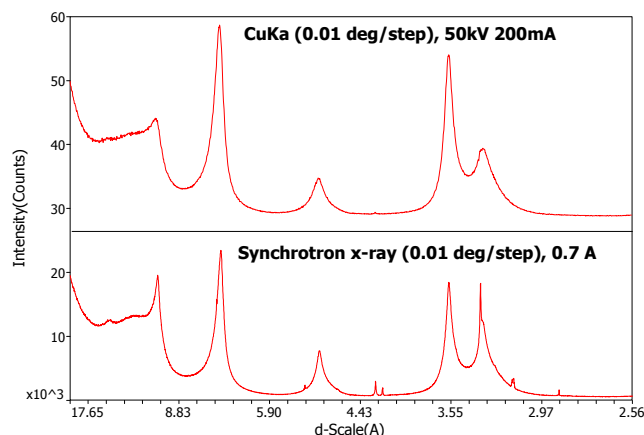


Figure 1. Comparison of XRD patterns of saturated oil sands, mature fine tailings (0.25 micron fraction).

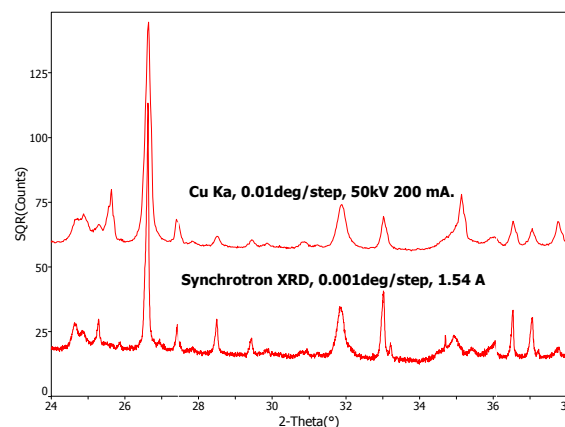


Figure 2. Diffraction patterns associated with the bitumen phase.